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ABSTRACT

Palmore's Facts on Aging Quiz (FAQ) (E. Palmore, 1977) is an instrument that is used to educate, to measure learning, to test knowledge, to measure attitudes toward aging, and in research. A comparative analysis was performed between the FAQ I and its multiple choice version and the FAQ II and its multiple choice version in terms of their item difficulty, their discrimination indices, and their guessing parameters by applying the three parameter model of item response theory. The internal consistency of the instruments was also examined. In all, 995 college freshmen took a version of the test. The results show that on the average the items on the multiple choice version of FAQ I and the multiple choice version of FAQ II were more difficult than the items on the true or false version of either test. The reason for this is that the probability of guessing an item correctly was drastically reduced in the multiple choice versions. Items on all versions appeared to be equally discriminatory, except in the FAQ I. The internal consistency of all versions was very low, but the multiple choice version of the FAQ II appeared more reliable than its true or false version. The reverse was the case for the FAQ I. To lend more credence to the use of FAQ I and FAQ II as a teaching tool more revision and testing need to be done. In the meantime, the use of multiple choice versions is recommended since guessing is drastically reduced. (Contains 8 tables and 25 references.) (Author/SLD)

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An Item Response Theory Analysis of Palmore's Facts on Aging Quiz (FAQ) using the Three Parameter Model.

ABSTRACT

Palmore's Facts on Aging Quiz(FAQ) is an instrument that is used to educate, to measure learning, to test knowledge and to measure attitude toward aging. It has also been used extensively for research purposes in various areas of gerontological disciplines, including assessment and cross-cultural comparisons. The purpose of this study is to do a comparative analysis between FAQ I and its multiple choice version, FAQ II and its multiple choice version in terms of their item difficulty, their discrimination indices, and their guessing parameter by applying the three parameter model of item response theory. The internal consistency of the instruments was also examined.

The results clearly showed that on the average the items on the multiple choice version of FAQ I and the multiple choice version of FAQ II were more difficult than the items on the True or False version of FAQ I and II, respectively. The reason for this is that the probability of guessing an item correctly was drastically reduced in the multiple choice versions. Items on all versions appear to be equally discriminatory except in FAQ I. Also, the internal consistency of all versions was very low but the multiple-choice version of FAQ II appear to be more reliable than its True or False version. The reverse was the case in FAQ I.

In summary, in order to bestow more credence to the use of FAQ I or FAQ II as a pedagogical tool, more revision and testing need to be done. The revision could bring the internal consistency to an acceptable level of at least .70. Meanwhile, the recommendation is to use the multiple-choice version since guessing is drastically reduced.

An Item Response Theory Analysis of Palmore's Facts on Aging Quiz (FAQ) using the Three Parameter Model.

Facts on Aging Quiz(FAQ)I & II were developed by Palmore (1977, 1980, 1981, 1992) primarily for the following purposes: to educate, to measure learning, to test knowledge and to measure attitudes regarding aging. According to Palmore (1988) FAQ is most commonly used to stimulate discussions and to unveil misconceptions about aging. The identification of the common misconceptions can then lead to the development of appropriate educational materials for students. FAQ can be used as an assessment tool in gerontology via pretest and posttest. The difference between the scores of the two tests can serve as a measure of change of learning at those time periods. Similarly, FAQ can be used to test knowledge level and misconceptions in different groups. Armed with this information corrective measure can be designed to alleviate the misconceptions and predijuices of those groups. The scores on FAQ can also be interpreted as a measure of attitude towards aged. However, Palmore (1988) contioned that those score may not be the best indicators of attitude toward the aged.

Numerous studies have been done using FAQ I or II. For example, Karner, DeLisi, Rheinheimer, & Due (1998) studied the attitude and knowledge of hospital personnel toward the elderly. They gave a two-hour workshop to these hospital employees during which time the participants were pretested and posttested using Palmore's FAQ. They found a significant increase in scores. Several other studies have used pretest and posttest model in order to measure attitudinal change and knowledge gain toward the elderly (Knapp, & Stubblefield, 1998; Shoemaker, Bowman, & Lester, 1998; Shenk, & Lee, 1995; Shffler, 1995). In all these pre and postest model studies using FAQ, participants experienced significant change in attitude and significant gain in knowledge toward the elderly.

Recently, Lusk, Hsuing, & Williams (1995) compared results on FAQ I and II obtained from freshmen nursing students in terms of the internal consistency of these instruments. They concluded that while the instrument is effective in stimulating discussion, in the interest of research purposes, however, it needs to be further revised and also tested.

Facts on Aging Quiz I (FAQ I) was designed in 1977. It contains 25 items of True or False questions about facts on aging. However, in 1981, FAQ I was revised with still 25 items of True or False questions but was called Facts on Aging Quiz II (FAQ II). In 1994, Harris & Changas (1994) developed a multiple-choice version of FAQ II. Harris, Changas & Palmore (1996) developed a multiple-choice version of FAQ I. Both multiple choice versions of FAQ contain 25 items, with four possible answers to each item.

Objective of the study:

The first purpose of this study is to do a comparative analysis between FAQ II and its multiple-choice version in terms of their item difficulty, their discrimination indices, their guessing parameter and their internal consistency. The second purpose is to do a comparative analysis between FAQ 1 and its multiple-choice version in terms of their item difficulty, their discrimination indices, their guessing parameter and their internal consistency. In both investigations, item response theory was employed in the analysis of the data.

Procedure:

In the spring semester of 1999, FAQ II the True or False version was administered to 270 freshmen. Likewise in the same semester, the multiple-choice version was administered to 230 different freshmen. In the fall semester of 1999, 255 freshmen were administered the FAQ I True or False version, and the same semester, 240 different freshmen students were also administered the FAQ I multiple choice version. This study took place in a two-year branch campus of a large northeastern Ohio university.

Background Information on Item Response Theory

Item response theory (IRT) is a mathematical model that relates the probability of answering an item on a test correctly to the ability of the student, the difficulty of the item, and the discrimination of the item (see equation 1). These three parameters, student ability, item difficulty, and the item discrimination, are unknown and will be inferred from the student responses (Hambleton, Swaminathan & Rogers, 1991; Hulin, Drasgow & Parsons, 1983; Lord, 1980).

$$P_i(\theta) = c_i + (1 - c_i)\frac{\exp Da_i(\theta - b_i)}{1 + \exp Da_i(\theta - b_i)} \qquad i = 1,2,.....n \qquad (1)$$

Equation 1 is the three parameter version of the item response theory (Birnbaum, 1968), where $P_i(\theta)$ is the probability of answering item i correctly, θ represents the ability of the student or the latent trait, b_i is the difficulty of item i, a_i is the discrimination index of item i, c_i is the lower asymptote of the item characteristic curve which corresponds to the probability of correct response to item i of the examinees with low θ, and D is a scaling constant and is usually set at 1.7.

Equation 1 collapses to two parameter model of IRT (Lord, 1952) if $c_i = 0$ (see equation 2).

$$P_i(\theta) = \frac{\exp Da_i(\theta - b_i)}{1 + \exp Da_i(\theta - b_i)} \qquad i = 1,2,.....n \qquad (2)$$

where $P_i(\theta)$, θ, b_i, a_i, D are the same as in equation 1.

Equation 1 reduces to one parameter model of IRT if $c_i = 0$, a_i=1, D=1(see equation 3).

$$P_i(\theta) = \frac{\exp(\theta - b_i)}{1 + \exp(\theta - b_i)} \qquad i = 1,2,.....n \qquad (3)$$

Equation 3 is often referred to as the Rasch model in honor of its developer (Rasch, 1966, 1980; Gustafsson, 1980; Harris, 1989).

Assumptions

The IRT models assume that a single dominant factor or ability accounts for examinee performance on the FAQ. This assumption is called unidimensionality. The assumption cannot be strictly met since there are other intervening factors that may affect test performance. Essentially, with regard to this study, what this assumption is saying is that if other intervening factors that may affect test performance are held constant, then the only factor responsible for examinee performance is the proficiency in the knowledge of aging. The second assumption, which is related to unidimensionality, is local independence. Local independence is the concept that the examinee's performance is only related to the latent trait. When the assumption of unidimensionality is met, so also is local independence (Lord & Novick, 1968).

Unidimensionality of FAQ II for True or False

In order to ascertain whether the assumption of unidimensionality was met in this study with regard to True or False version, two different methods were applied. In the first method, the item responses were submitted to tetrachoric factor analysis. Two factors were extracted(see Table 1). The first factor explained 16.77% of the total variance, while the second factor explained 1.30%. Bejar (1980) was the second method used in trying to establish the assumption of unidimensionality. The item difficulty of the subset items 1-7 were determined, and were compared to the item difficulty of item 1-7 obtained from the total sample. The correlation between the sets was .88. Based on the results of these two methods, it is reasonable to assume that the requirement of unidimensionality was met.

Unidimensionality of FAQ II for Multiple Choice

In order to ascertain whether the assumption of unidimensionality was met in this study with regard to multiple-choice version, two different methods were applied. In the first method, the item responses were submitted to tetrachoric factor analysis. Two factors were extracted (see Table 2). The first factor explained 12.74% of the variance, while the second factor explained 1.89%. Bejar (1980) was the second method used in trying to establish the assumption of unidimensionality. The item difficulty of the subset items 1-7 were determined, and were compared to the item difficulty of item 1-7 obtained from the total sample. The correlation between the sets was .97. Based on the results of these two methods, it is reasonable to assume that the requirement of unidimensionality was met.

Unidimensionality of FAQ I for Multiple Choice

In order to ascertain whether the assumption of unidimensionality was met in this study with regard to multiple-choice version, two different methods were applied. In the first method, the item responses were submitted to tetrachoric factor analysis. Two factors were extracted (see Table 3). The first factor explained 12.59% of the total variance, while the second factor explained 1.91%. Bejar (1980) was the second method used in trying to establish the assumption of unidimensionality. The item difficulty of the subset items 1-7 were determined, and were compared to the item difficulty of item 1-7 obtained from the total sample. The correlation between the sets was .86. Based on the results of these two methods, it is reasonable to assume that the requirement of unidimensionality was met.

Unidimensionality of FAQ I for True or False

In order to ascertain whether the assumption of unidimensionality was met in this study with regard to True or False version, two different methods were applied. In the first method, the item responses were submitted to tetrachoric factor analysis. Two factors were extracted (See Table 4). The first factor explained 19.91% of the total variance, while the second factor explained 0.96%. Bejar (1980) was the second method used in trying to establish the assumption of unidimensionality. The item difficulty of the subset items 1-7 were determined, and were compared to the item difficulty of item 1-7 obtained from the total sample. The correlation between the sets was .80. Based on the results of these two methods, it is reasonable to assume that the requirement of unidimensionality was met.

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Checking the model fit

It is required that the fit of the IRT model to the data be assessed before their application. The fit to a set of test data implies that the model can explain the data. It also means that the ability estimates obtained from different sets of test items will be the same, while the item parameter estimates derived from different groups of examinees will also be the same. This characteristic of IRT models is called the property of invariance.

In this study, the item fit statistics for the three-parameter model were provided by the use of the computer program BILOG. This program reported the chi-square statistics for the fit of each item. Of the 25 items none was misfitted because all the reported probabilities under the chi-square were greater than the chosen critical probability of .01 and this is with regard to FAQ I True or False, FAQ II, True or False, FAQ I multiple choice and FAQ II multiple choice. The implication here is that the three-parameter model did fit the data.

Before the item difficulty, the guessing parameter and the discrimination indices of FAQ II True or False and FAQ II Multiple choice version as well as FAQ I True or False and FAQ I Multiple choice version are to be compared, the proficiency level of facts on aging of the competing samples must first be established. Essentially, for these comparisons to have any validity, the average proficiency level of the competing samples must be equal.

The mean proficiency level of FAQ II True or False was 0.04 (SD = 1.076) while the mean proficiency level of FAQ II Multiple choice was –0.043 (1.058). Their difference was not significant. Similarly, the mean proficiency level of FAQ I True or False was 0.013 (SD = 0.872) while the mean proficiency level of FAQ I Multiple choice was 0.016 (SD = 0.731). Their difference was not significant. The implication here is that at the time of the administration of the quiz, all students who participated, on the average, are on the same level of proficiency with regard to facts on aging.

Analysis of Table 5: Item Difficulty, Guessing Parameter, Discrimination index

The mean of the item difficulty of the FAQ II True or False version was –0.23 (SD = 2.75) while the mean of the item difficulty of the FAQ II for the multiple choice version was 0.665 (SD = 2.39). The difference between the two means were found to be significant, $t(270) = -3.93$, $p<.05$. This may suggest that on average the Multiple choice version of FAQ II appear to be more difficult.

The mean of the guessing parameter of the FAQ II True or False version was 0.25(SD = .08), while the mean of the guessing parameter of the FAQ II multiple choice version was 0.06(SD = 0.00). The difference between the two means was found to be significant, $t(238) = 39.57$, $p<.05$. This may suggest that the probability of answering an item correctly by guessing was significantly reduced in the multiple choice version of the FAQ II.

The mean of the discrimination index (DI) for the True or False version of FAQ II was 0.65(SD = .29), while the mean of the DI for the multiple-choice version of the FAQ II was 0.66(SD = .17). The difference between the means was not significant.

Analysis of Table 6: Item Difficulty, Guessing Parameter, Discrimination index

Similarly, the mean of the item difficulty of the FAQ I True or False version was –1.20 (SD = 1.47) while the mean of the item difficulty of the FAQ I for the multiple-choice version was 0.99 (SD = 2.45). The difference between the means was found to be significant, $t(240) = 12.17$, $p<.05$. This may suggest that on average the Multiple-choice version of FAQ I appear to be more difficult.

Likewise, the mean of the guessing parameter of the FAQ I True or False version was 0.13(SD = .0001), while the mean of the guessing parameter of the FAQ I multiple choice version was 0.011(SD = 0.0001). The difference between the two means was found to be significant, $t(240) = -1.47 \times 10^{9}$, $p<.05$. This may suggest that the probability of answering an item correctly by guessing was significantly reduced in the multiple choice version of the FAQ I.

The mean of the discrimination index (DI) for the True or False version of FAQ I was 1.20(SD = .62), while the mean of the DI for the multiple-choice version of the FAQ I was 0.46(SD = .31). The difference between the means was found to be significant, $t(240) = -16.44$, $p<.05$. The implication here could be that items in the FAQ I True or False have greater discrimination power than items in its multiple choice version.

Analysis of Table 7: Internal Consistency of FAQ II

Table 7 shows the internal consistency of the True or False and the Multiple choice(MC) versions of the FAQ II. The internal consistency for True or False version was .07 while that of multiple choice version was .27. Clearly, both have very low internal consistency reliability, however, the MC version did improve the average correlation among the items.

Analysis of Table 8: Internal Consistency of FAQ I

Table 8 shows the internal consistency of the True or False and the Multiple choice(MC) versions of the FAQ I. The internal consistency for True or False version was .45 while that of multiple-choice version was .30. Clearly, both have very low internal consistency reliability, however, the MC version did not improve the average correlation among the items. This result is contrary to the internal consistency of FAQ II in which the multiple-choice version was more reliable.

Discussions

The first purpose of this study is to do a comparative analysis between FAQ II and its multiple-choice version in terms of their item difficulty, their discrimination indices, their guessing parameter and their internal consistency. The results clearly showed that on the average the items on the multiple-choice version of FAQ II were more difficult than the items on the True or false version even though the items in both versions are not different. The reason for this is that the probability of guessing an item correctly was drastically reduced in the multiple-choice version. The items on both versions appear to be equally discriminatory. The internal consistency of both versions was low but multiple choice version appear to be more reliable.

The second purpose is to do a comparative analysis between FAQ I and its multiple choice version in terms of their item difficulty, their discrimination indices, their guessing parameter and their internal consistency. On the average the Multiple choice version of FAQ I appear to be more difficult despite similarity of the items. Again, the reason could be that the probability of answering an item correctly by guessing was significantly reduced in the multiple-choice version. Items in the FAQ I True or False appear to have greater discrimination power than items in its multiple choice version. Unlike the FAQ II, the average correlation among the items in True or False version of FAQ I was greater than its multiple-choice version.

In summary, perhaps more revision and testing need to be done if the FAQ I or II are to be used as a pedagogical tool. The revision could bring the internal consistency to an acceptable level of at least .70 (Nunnally, 1978). The recommendation, however, is to use the multiple-choice version since guessing is drastically reduced.

Table 1. Tetrachoric Factor Analysis of FAQ II for True or False

Factor 1	Factor 2
-0.86	0.28
-0.84	-0.06
-0.70	-0.40
-0.93	0.20
-0.58	0.22
-0.98	-0.06
-0.80	0.03
-0.64	0.21
-0.81	0.29
-0.55	-0.21
-0.71	-0.44
-0.85	0.26
-0.92	0.19
-0.51	-0.31
-0.68	-0.38
-0.81	0.19
-0.96	-0.03
-0.96	-0.08
-0.71	-0.31
-0.90	0.27
-0.97	0.07
-0.98	-0.10
-0.82	-0.16
-0.70	-0.03
-0.99	0.00

Table 2 . Tetrachoric Factor Analysis of FAQ II for Multiple Choice Version.

Factor 1	Factor 2
-0.80	0.38
-0.68	0.30
-0.14	0.32
-0.94	0.19
-0.42	0.19
-0.88	-0.24
-0.56	0.26
-0.71	-0.31
-0.75	-0.05
-0.60	-0.66
-0.43	-0.39
-0.89	0.17
-0.90	0.05
-0.78	0.26
-0.71	0.21
-0.85	-0.08
-0.82	0.04
-0.56	0.13
-0.70	-0.22
-0.51	-0.45
-0.75	0.14
-0.85	-0.21
-0.52	-0.40
-0.62	-0.03
-0.86	0.19

Table 3. Tetrachoric Factor Analysis of FAQ I for Multiple Choice Version.

Factor 1	Factor 2
-0.66	0.10
-0.79	-0.23
-0.69	0.42
-0.71	-0.22
-0.94	0.24
-0.59	-0.56
-0.56	0.22
-0.72	-0.47
-0.73	-0.39
-0.69	-0.33
-0.81	0.28
-0.62	-0.13
-0.78	0.28
-0.80	-0.12
-0.50	0.35
-0.74	-0.15
-0.60	0.19
-0.47	0.05
-0.53	0.30
-0.72	-0.09
-0.97	0.07
-0.61	0.30
-0.76	-0.27
-0.77	0.31
-0.73	-0.04

Table 4. Tetrachoric Factor Analysis of FAQ I for True or False Version.

Factor 1	Factor 2
-0.88	0.30
-0.97	0.01
-0.88	0.29
-0.93	-0.06
-0.97	0.18
-0.85	-0.35
-0.84	0.11
-0.95	0.05
-0.98	-0.13
-0.95	-0.10
-0.81	0.39
-0.95	-0.03
-0.95	0.17
-0.96	0.00
-0.82	-0.18
-0.94	-0.19
-0.88	0.05
-0.75	-0.45
-0.88	0.02
-0.82	-0.14
-0.96	0.05
-0.72	-0.17
-0.79	-0.23
-0.89	0.01
-0.95	0.17

Table 5 . The Discrimination, Difficulty, and the Guessing parameter of FAQ II regarding True or False and Multiple Choice Version in a Comparative Matrix.

Items	a_{TF}	a_{MC}	b_{TF}	b_{MC}	c_{TF}	c_{MC}
1.	0.74	0.69	-2.43	-1.27	0.21	0.06
2.	0.75	0.49	-0.94	-1.62	0.20	0.06
3.	0.45	0.35	-0.20	1.34	0.26	0.06
4.	0.66	0.78	1.86	3.67	0.32	0.06
5.	0.67	0.72	-1.54	-2.64	0.22	0.06
6.	0.62	0.46	3.61	4.95	0.20	0.06
7.	0.09	0.79	-7.92	-4.02	0.50	0.06
8.	0.28	0.46	0.67	3.85	0.31	0.06
9.	1.00	0.91	1.93	1.10	0.23	0.06
10.	0.69	0.41	-0.20	0.76	0.23	0.06
11.	0.97	0.50	2.55	2.77	0.13	0.06
12.	1.05	0.74	2.04	2.58	0.27	0.06
13.	0.29	0.53	-1.93	-1.38	0.23	0.06
14.	0.71	0.86	-1.61	-1.60	0.20	0.06
15.	0.76	0.71	3.77	-0.15	0.10	0.06
16.	0.67	1.02	3.18	-1.07	0.27	0.06
17.	1.01	0.66	-0.05	-0.93	0.21	0.06
18.	0.41	0.70	-2.20	-0.48	0.22	0.06
19.	0.38	0.55	-2.93	3.29	0.23	0.06
20.	1.34	0.85	1.561	1.22	0.32	0.06
21.	0.29	0.64	-1.79	3.12	0.23	0.06
22.	0.50	0.62	-2.52	0.18	0.21	0.06
23.	0.53	0.92	-4.05	-2.58	0.21	0.06
24.	0.59	0.61	0.83	3.01	0.31	0.06
25.	0.76	0.58	2.55	1.72	0.35	0.06

Note: a_{TF} = Discrimination indices for True or False, a_{MC} = Discrimination indices for Multiple Choice, b_{TF} = Difficulty parameter for True or False, b_{MC} = Difficulty parameter for Multiple Choice, c_{TF} = Guessing parameter for True or False, c_{MC} = Guessing parameter for Multiple Choice.

Table 6 . The Discrimination, Difficulty, and the Guessing parameter of FAQ I regarding True or False and Multiple Choice Version in a Comparative Matrix.

Items	$a^{\bullet}_{TF}$	$a^{\bullet}_{MC}$	$b^{\bullet}_{TF}$	$b^{\bullet}_{MC}$	$c^{\bullet}_{TF}$	$c^{\bullet}_{MC}$
1.	1.86	0.23	-2.18	0.62	0.13	0.01
2.	0.58	0.34	-1.16	1.92	0.13	0.01
3.	1.84	0.48	-1.79	-0.24	0.13	0.01
4.	0.47	0.24	-1.60	0.59	0.13	0.01
5.	2.17	0.22	-1.94	1.06	0.13	0.01
6.	0.52	0.29	-3.64	-5.63	0.13	0.01
7.	1.64	1.31	0.16	2.36	0.13	0.01
8.	0.91	0.39	-0.09	2.74	0.13	0.01
9.	0.80	0.47	-1.99	1.15	0.13	0.01
10.	1.76	1.25	-1.68	0.46	0.13	0.01
11.	2.48	0.73	-0.60	1.75	0.13	0.01
12.	0.46	0.23	0.00	-2.14	0.13	0.01
13.	1.14	0.26	-3.88	3.50	0.13	0.01
14.	0.56	0.22	-3.55	-' 93	0.13	0.01
15.	1.04	0.31	-2.31	-0.61	0.13	0.01
16.	1.36	0.24	0.05	3.86	0.13	0.01
17.	2.06	0.36	-0.73	-0.07	0.13	0.01
18.	1.16	0.52	-0.56	1.97	0.13	0.01
19.	2.05	0.30	1.35	5.85	0.13	0.01
20.	0.78	0.25	-1.27	4.60	0.13	0.01
21.	1.16	0.43	0.19	1.37	0.13	0.01
22.	0.69	0.87	-3.12	-2.17	0.13	0.01
23.	0.70	0.24	1.27	3.46	0.13	0.01
24.	1.29	0.82	0.74	0.33	0.13	0.01
25.	0.50	0.49	-1.53	-0.13	0.13	0.01

Note: $a^{\bullet}_{TF}$ = Discrimination indices for True or False, $a^{\bullet}_{MC}$ = Discrimination indices for Multiple Choice, $b^{\bullet}_{TF}$ = Difficulty parameter for True or False, $b^{\bullet}_{MC}$ = Difficulty parameter for Multiple Choice, $c^{\bullet}_{TF}$ = Guessing parameter for True or False, $c^{\bullet}_{MC}$ = Guessing parameter for Multiple Choice.

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Table 7. The Internal Consistency of FAQ II regarding True or False and Multiple Choice Version in a Comparative Matrix.

True or False Version	Multiple Choice Version
.07	.27

Table 8. The Internal Consistency of FAQ 1 regarding True or False and Multiple Choice Version in a Comparative Matrix.

True or False Version	Multiple Choice Version
.45	.30

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